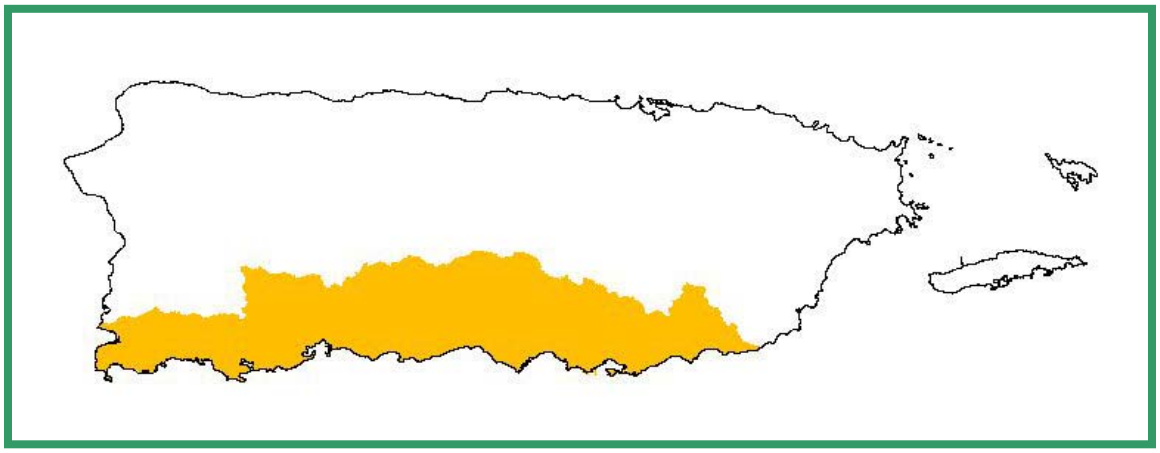
# CONSERVATION SECURITY PROGRAM

# SOUTHERN WATERSHED

# (21010004)



## 2006

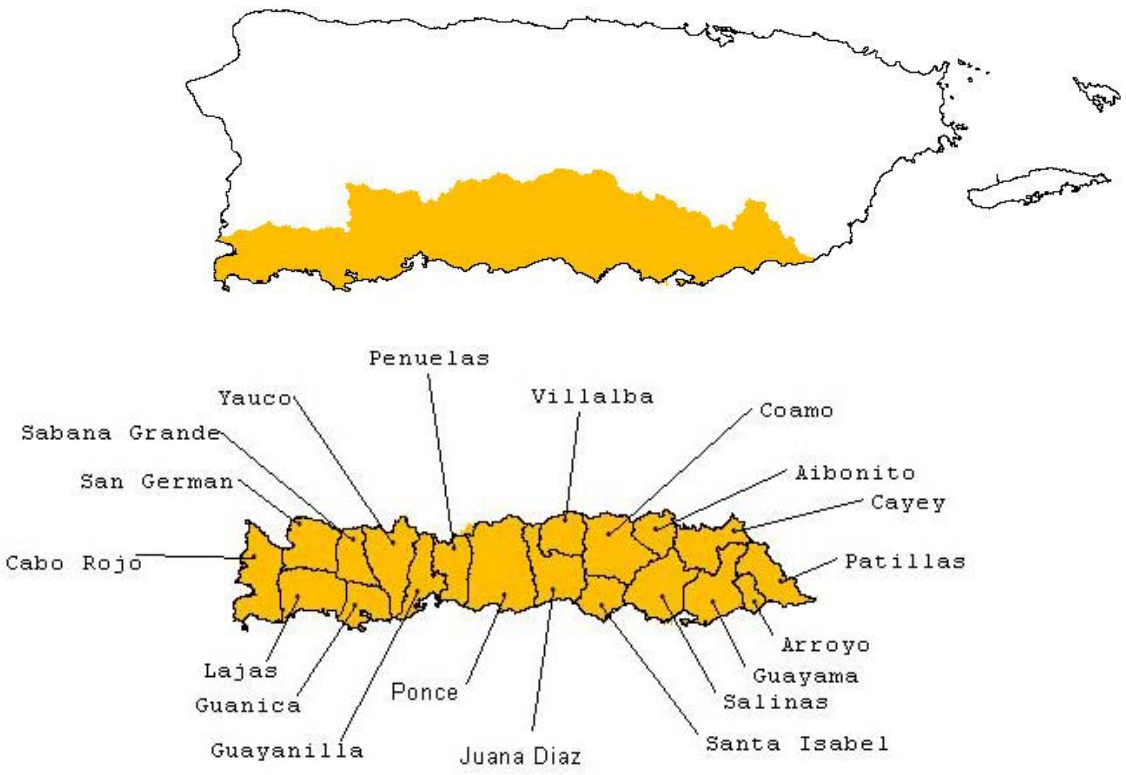
# Introduction

The Southern Puerto Rico 8-Digit Hydrologic Unit Code (HUC) has an extension of 545,280 acres, which covers about 24% of the main Island of Puerto Rico. The watershed is comprised of nineteen municipalities, extending from Cabo Rojo in the southwest toward Patillas in the southeast. Aibonito, Cayey, Cabo Rojo, Sabana Grande and San Germán are partially within the watershed and excluded for the analysis. Approximately 74% is in the semiarid region and the rest in the humid part.

Watershed is well diversified in the production of agricultural commodities, coffee, orchards, animal feeding operations, and beef cattle production. Water conservation concerns predominate over the entire semiarid region and soil erosion on the upland. Agricultural water management consists of measures to increase or conserve present or future water supplies in rural areas, improve water quality impaired by nonpoint source pollutants, and increase the efficiency of water management for agricultural purposes.

Conservation assistance is provided by four NRCS Service Centers, one Soil Survey office, and one Resource Conservation and Development (RC&D) office.

**Figure 1. Southern Puerto Rico 8-Digit HUC Watershed**



## Physical Description

The Southern Watershed has an extension of 545,280 acres. From this total, 24% is in humid upland, 32% in semiarid upland, 42% in semiarid alluvial land and 2% in humid alluvial land. Acreage of cropland and pastureland is shown in Table 1. Total irrigated land is 21,405 acres (9.6%) of semiarid land. Most of the best irrigated prime farm land soils for crop production are in the semiarid alluvial land. Of 269 systems, drip irrigation predominates with a 64%, followed by gravity with a 24% and 12% for sprinkler. Deep well is main source of water for irrigation. There are two water districts that supply water in the semiarid region.

Table 1. Farm Land Cover

| Farm Land Cover | Acres | % HUC |
|---|---|---|
| Cropland | 48,614 | 8.9 |
| Pastureland | 108,149 | 19.8 |
| Other land | 388,517 | 71.3 |
| Total | 545,280 | 100% |

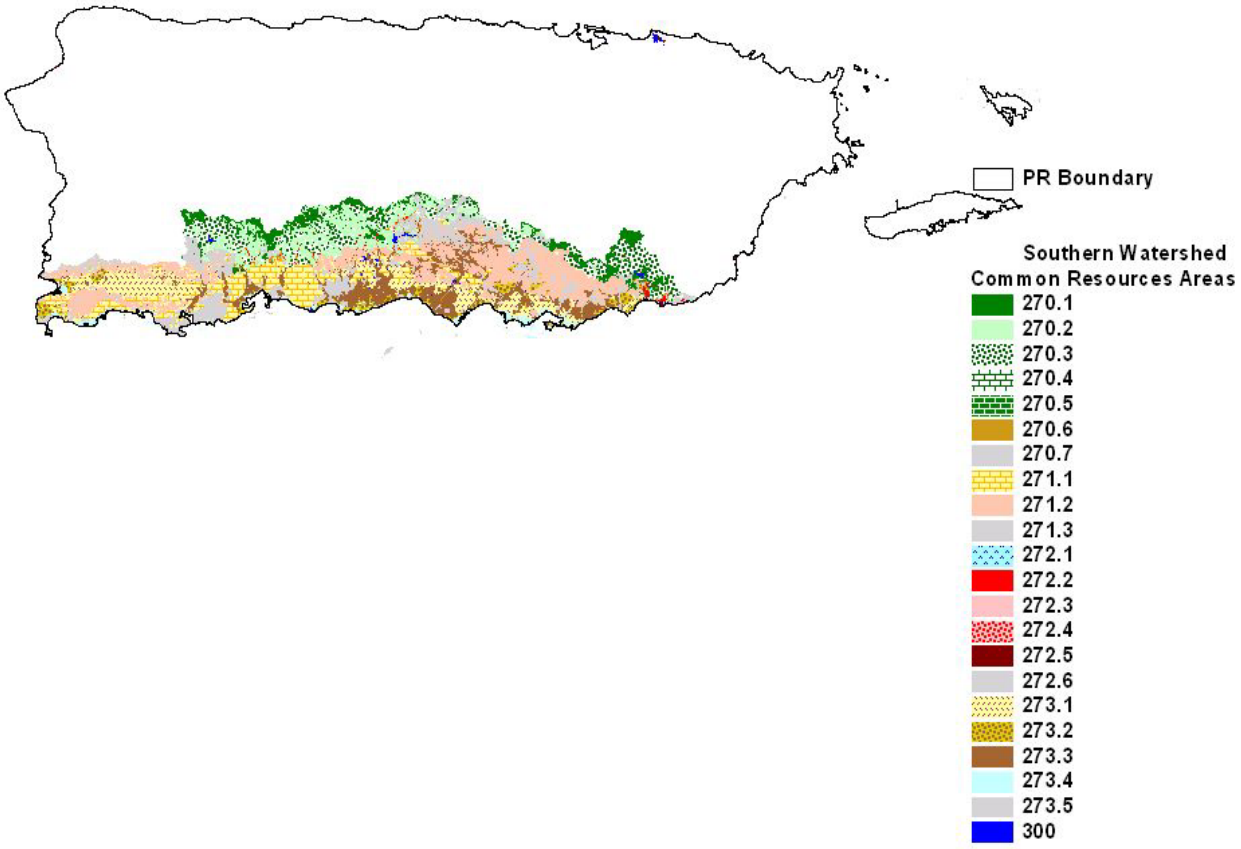
Irrigated row crops (vegetables, onion, banana) are grown in the semiarid alluvial land while most orchards (coffee, citric, avocados), plantains and root crops are grown in the humid upland. Specialty crops such as pigeon peas and pumpkin are cultivated in the semiarid upland. Native and naturalized pasture predominates all over the region, with few irrigated hayland.

There are about 214 animal feeding operations in the watershed: 143 (67%) are in poultry, 66 (31%) are hogs and 5 (2%) are dairies.

## Common Resources Areas (CRA)

The CRA represent agroecologically homogeneous areas where landscapes resource concerns and treatment needs are similar. The CRA for the Caribbean basin are based mainly on soil classification and soil surveys already published and ongoing updates. Other resources information such as geology, climatic data, and geography land use, life zone areas, and social and economic factors are related to set groups of similar agroecosystems. Only the predominant Common Resources Areas are described below.

**Figure 2. Common Resources Area in the Island of Puerto Rico**



### 270.1 Deep, Reddish, Clayey Soils in the Humid Volcanic Upland

This area includes soils that are highly leached and have low base saturation in the subsurface that contains a significant amount of illuvial clay accumulation and high organic content in the surface horizon. The soils are deep, well drained, very strongly acid, and moderately permeable. These soils are on side slopes and narrow ridge tops of the humid uplands. They formed in residual material weathered from volcanic rock. Slope, runoff, past erosion, and hazard of further erosion are limitations. Natural fertility is medium. The Humatas complex is suitable for use as native pasture and woodland and for wildlife food and cover.

### 270.2 Shallow Clayey Soils in the Humid Volcanic Upland

This area includes soils exhibiting initial stages of soil formation. Soils are shallow to moderately deep, steep to very steep, and well-drained soils to poorly drained in the higher areas of the volcanic humid upland. Soils formed on foot slopes, side slopes, and rounded hilltops of strongly dissected humid volcanic upland. Reaction in the surface layer and subsoil is very strongly acid. Natural fertility ranges from low to medium. The hazard of erosion is the major concern of management. Some areas severely eroded exposed bedrock.

### 270.3 Shallow Sandy and Gravelly Soils in the Humid Volcanic and Plutonic Upland

This area includes soils exhibiting initial stages of soil formation, consisting of shallow to moderately deep gravelly, steep to very steep, and well-drained soils. These soils formed on foot slopes, side slopes, ridge and hilltops of strongly dissected humid volcanic and plutonic upland. Some areas formed in residual material weathered from serpentine rock in the western part of the island of Puerto Rico. Erodibility is higher in granitic soils such as Pandura and Pellejas. Natural fertility is low and acidity is strong. Shallow to mixture of weathered and partially weathered volcanic rock. Slope, shallowness to bedrock, rapid runoff, and erosion hazard are the major concerns of management.

### 271.1 Shallow and Moderately Deep Soils in the Semiarid Calcareous Upland

This area includes shallow to moderately deep in sloping and rolling alluvial fans and steep to very steep soils. Soils formed on foot slopes, side slopes, and rounded hilltops and narrow ridge tops in the calcareous semiarid area. Most soils have a nearly black, organic rich surface horizon with a high supply of bases. Permeability is moderate. Natural fertility is medium to high. Slopes, shallowness to bedrock, hazard of erosion, low and poorly distributed rainfall are the major resource concerns.

### 271.2 Shallow and Moderately Deep Soils in the Semiarid Volcanic Upland

This area includes soils exhibiting initial stages of soil formation, consisting of shallow, moderately steep to very steep and well-drained soils. Soils formed on foot slopes, long and short side slopes, hilltops, and ridge tops in the semiarid volcanic upland. Soils on Vieques Island formed in partly weathered granitic rocks and they are less fertile than other similar soils. Rapid runoff, erosion hazard, low and poorly distributed rainfall, and limitation on the use of equipment is the major concern of management. Some areas severely eroded exposed bedrock.

### 273.1 Moderately Deep Foot slope Soils in the Semiarid Alluvial Land

This area includes deep to moderately deep soils with nearly black, organic rich surface horizon and high supplies of bases, which are intermittently dry for long periods during the warm season of the year. They are nearly level to strongly sloping soils on alluvial fans, terraces and foot slopes in the semiarid area. These soils formed in fine texture sediment and fine textured residuum that was derived from basic volcanic rock, receiving influence from calcareous material from limestone hills. Soils on lower position are deeper and show an increase in clay illuviation in the subsoil. Permeability is moderately slow. Natural fertility is high and runoff is medium. Low and poorly distributed rainfall is a severe limitation, hazard of erosion and poor workability are the major resource concerns.

### 273.2 Deep Shrink and Swelling Soils in the Semiarid Alluvial Land

This area includes dark colored clay soils with a high content of expanding lattice clay. They are formed along the semiarid southern coast and in the Lajas Valley depression. Soils are deep, moderately well drained to somewhat poorly drained, nearly level and gently sloping. These soils are medium to high natural fertility. Salt accumulation may occur in depression.

### 273.3 Deep Sandy and Gravelly Soils in the Semiarid Alluvial Land

This area includes nearly level to strongly sloping soils with a relative high saturation, a subsurface horizon that contains a significant content of illuvial clay accumulation. They are intermittently dry for long periods during the year. These soils are moderate deep to deep, well to excessively drained and moderate to rapid permeable soils. They are formed in moderately coarse to fine textured gravelly stratified sediment derived from volcanic rock. Coarse textured soils are excessively drained and have low fertility. Runoff is medium. Low rainfall, slopes, hazard of erosion and poor soil workability are the major resource concerns.

### 273.4 Deep Dark Friable and Fertile Soils in the Semiarid Alluvial Land

This area includes soils with nearly black, organic rich surface horizon and high supplies of bases that are intermittently dry for long periods during the warm season of the year. They are nearly level to sloping soils on foot slopes, alluvial fans and terraces in the semiarid area. These soils formed in medium textured and moderately fine textured sediment that is influenced from limestone and volcanic rock. Areas closer to riverbank are excessively drained because soils have stratified layers of sand and gravel. They have moderate permeability, moderate to high available water capacity and medium to high natural fertility. Runoff is slow. Poor rainfall distribution and flooding susceptibility are the major resource concerns.

## Water Resources

### Drinking Water System

According to the Environmental Protection Agency *Safe Drinking Water Information System (SDWIS*), the population served by ground water is about 266,945 (30%).

The municipalities of Guánica, Guayanilla, Salinas and Santa Isabel are served 100% of ground water source. Surface water supplied about 70% of drinking water needs and ground water 30%. For the detail of the served population by type of source see Table 2.

Table 2. Population Served by Primary Water Source Type

| Municipality | Population Served by Primarily Water Source Type | |
|---|---|---|
| | Ground water | Surface Water |
| Lajas | --- | 46,228 |
| Yauco | 452 | 56,474 |
| Guánica | 58,943 | --- |
| Guayanilla | 15,027 | --- |
| Peñuelas | No systems were found | |
| Villalba | 4,601 | 47,929 |
| Juana Díaz | 41,470 | 31,756 |
| Ponce | 13,334 | 279,068 |
| Patillas | 4,855 | 53,720 |
| Arroyo | No systems were found | |
| Guayama | 5,739 | 61,279 |
| Salinas | 48,118 | --- |
| Santa Isabel | 73,506 | --- |
| Coamo | 900 | 48,811 |
| Source: EPA- Safe Drinking Water Information System (SDWIS) Results are based on data extracted on: APR-09-2005 | | |

## Surface and Ground Water

In the Atlas of Ground-Water Resources in Puerto Rico and the U.S. Virgin Islands, prepared by the U.S. Geological Survey (USGS) in cooperation with the U. S. Environmental Protection Agency (EPA), the main island of Puerto Rico was divided into five ground water areas: North Coast, South Coast, West Coast, East Coast, and East Central.

The 2006 CSP watershed includes the south coast ground water area divided in USGS Atlas in three regions: Santa Isabel-Patillas, Juana Díaz-Ponce and the Peñuelas-Guánica regions; and the Lajas region included in the west coast ground water area.

| Region | Acres |
|---|---|
| Santa-Isabel Patillas | 57,600 |
| Juana Díaz-Ponce | 51,200 |
| Peñuelas-Guánica | 19,200 |
| Lajas | 22,400 |

## Surface water bodies

The most important surface water features by region are:

**Region - Santa-Isabel Patillas:** Río Grande de Patillas, Río Nigua of Arroyo, Río Guamaní, Río Seco, Río Nigua of Salinas, Río Jueyes, Río Cayeres, Río Coamo, Río Cuyón, Río Lapa, and Río Descalabrado. A complex irrigation-canal system constructed between 1914 and 1916 transfers water from Patillas, Coamo, Guayabal, and Carite lakes to the many farms in the region.

**Region - Juana Díaz-Ponce:** Río Cañas, Río Portugués, Río Bucaná, Río Inabón, Río Jacaguas, and Lago Toa Vaca. There are numerous stream diversions, canals, and storage lakes in the Juana Díaz- Ponce region that are used mainly for agriculture.

**Region - Peñuelas-Guánica:** Río Tallaboa, Río Macaná, Río Guayanilla, Río Yauco, and Río Loco.

**Region – Lajas:** Small and ephemeral Laguna Cartagena and Bahía Boquerón natural streams. Man-induced surface water flow in a gravity-fed irrigation canal that extends westward.

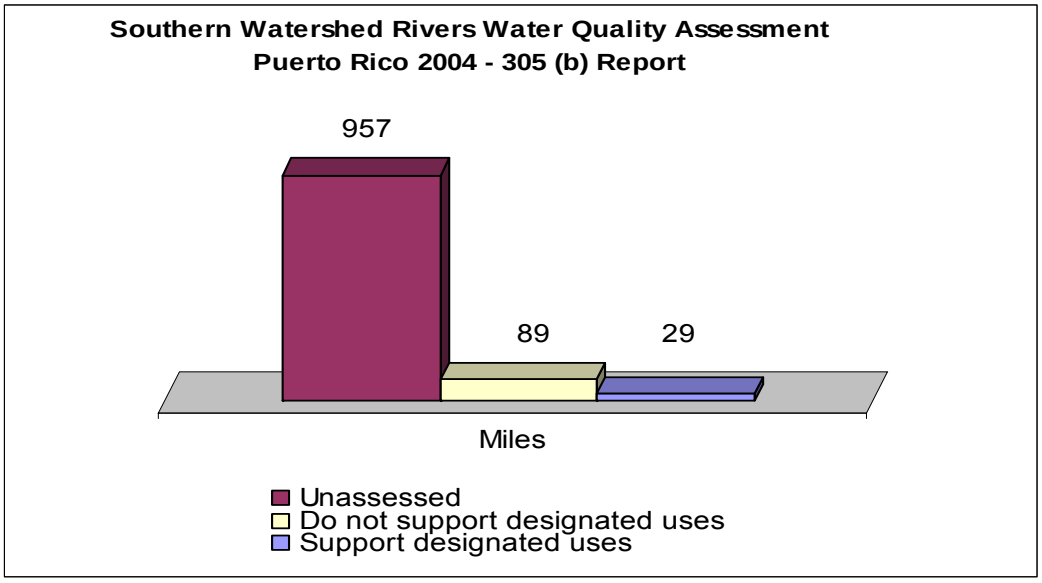
## Resource Concerns

### Soil Quality

Sheet and rill erosion by water on the watershed for cropland and pastureland has been reduced 142,586 ton/acre/year in 2003 and 267,408 ton/acre/year in 2002. Soil erosion control not only maintains soil productivity but reduces transport of agrichemicals to water bodies. Conservation tillage practice on upland soils may reduce erosion rate on plantains from 29 tons/acre/year down to 2.5 tons/acre/year. Soil erosion on semiarid alluvial land is insignificant.

### Water Quality of Surface Water

Of the total of 1,075 miles, 89 miles are waters in which one water quality standard is not attained the designated use such as swimming (primary contact recreation), secondary contact recreation and raw source of drinking water. This segment required the development and implementation of a Total Maximum Daily Load (TMDL).




Pollutants and Stressors Impacting Rivers and Streams: Bacteria, Heavy metals, Ammonia, Cyanide, Surfactants and Phosphorous

Sources of Pollutants Impacting Rivers and Streams: Onsite wastewater system Agriculture (Special Crop Production, Confined Animal Feeding Operations), Urban Runoff/Storm, Municipal Point Sources, Industrial Point Source, Collection System Failure, Landfill and Resource Extraction

The total of 1,148 acres of lakes surface area was considered to be impaired for aquatic life due to violation of the dissolved oxygen standard (≥ 5mg/l). High concentration of nutrients, possibly from agricultural activities and onsite wastewater disposal system

has been identified as important factor contributing to the reduced dissolved oxygen concentration.

**Water Conservation for Irrigated Land**

Water conservation is an extremely important resource concern in the semiarid land for irrigated cropland production and water supply for animal enterprise. Water is threatened by real estate development and other uses. A water conservation project in agreement with Soil and Water Conservation District and Puerto Rico Department of Agriculture is actively involved with farmers to provide them alternatives to improve irrigation system management, build open channels and irrigation water reservoirs to recharge ground water aquifer and improve system efficiency.

The following table summarizes the resource concerns/issues by land use.

| SWAPA | Specific Resource Concern | Pasture/Hay | Row Crops | Orchards |
|---|---|---|---|---|
| Soil Erosion | Sheet and Rill | | X | X |
| | Concentrated Flow | | X | |
| | Irrigation Induced | | X | X |
| Soil Condition | Organic Matter, Salinity | | X | |
| Water Quantity | Water Management for Irrigated Land | | X | |
| | Runoff control | | X | |
| Water Quality | Pesticide | | X | X |
| | Nutrients | | X | X |
| Plant Condition | Productivity Health and Vigor | X | X | X |
| Animal Habitat, Domestic | Water Quantity and Quality | X | | |

Pasture and Hay Lands: Major concern involves control of invasive pests and maintaining good pasture condition.

Row Crops: Major concern involves potential contamination from pesticides and nutrients.

Orchards: Major concern involves potential contamination from pesticides and nutrients.

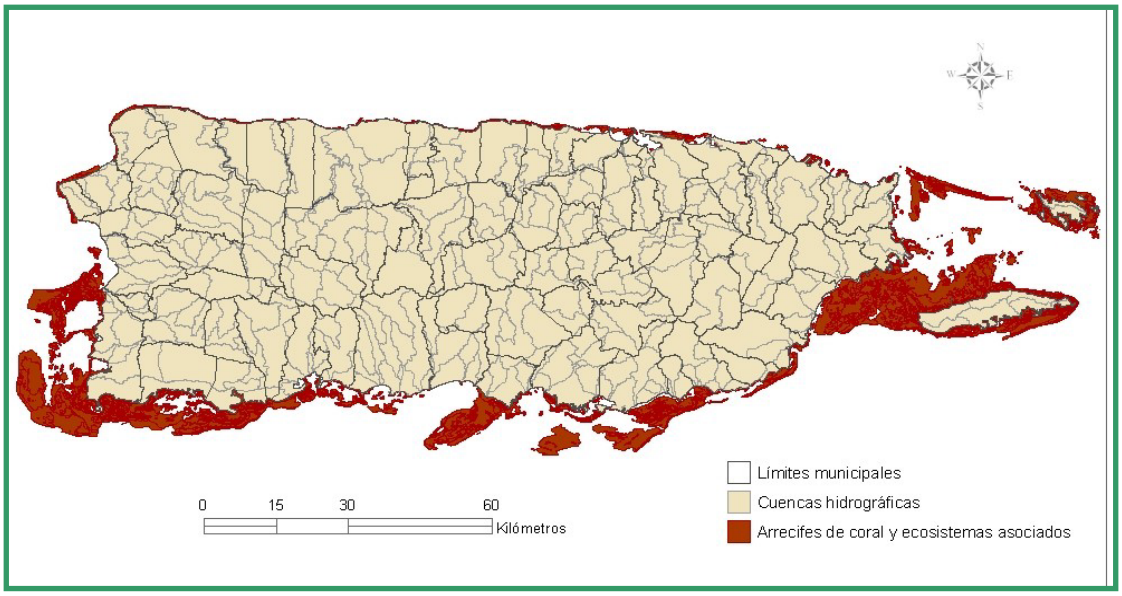
## Southern Ecological and Agricultural Resources

### Coral Reef

Puerto Rico has an estimated coastline of 578 miles and a land area of about 2 million acres. Corals grow throughout most of the insular shelf along the northeast, east, and southern coastlines (*J.R. García et al*) (Shown in reddish brown on Figure 3). The southwestern area, at La Parguera, has a broad landward indentation fringed with mangroves, mud flats and shallow saline lagoons.

Overall, 93% of Puerto Rico's reefs were rated as threatened in the reefs at risk analysis, with 84% at high risk and therefore, among the most threatened in the Caribbean (*D.D. Turgeon et al*). High sediment inputs and increased turbidity have degraded water quality around all the reefs off Puerto Rico's southern coast.

**Figure 3. Puerto Rico Coral Reef**

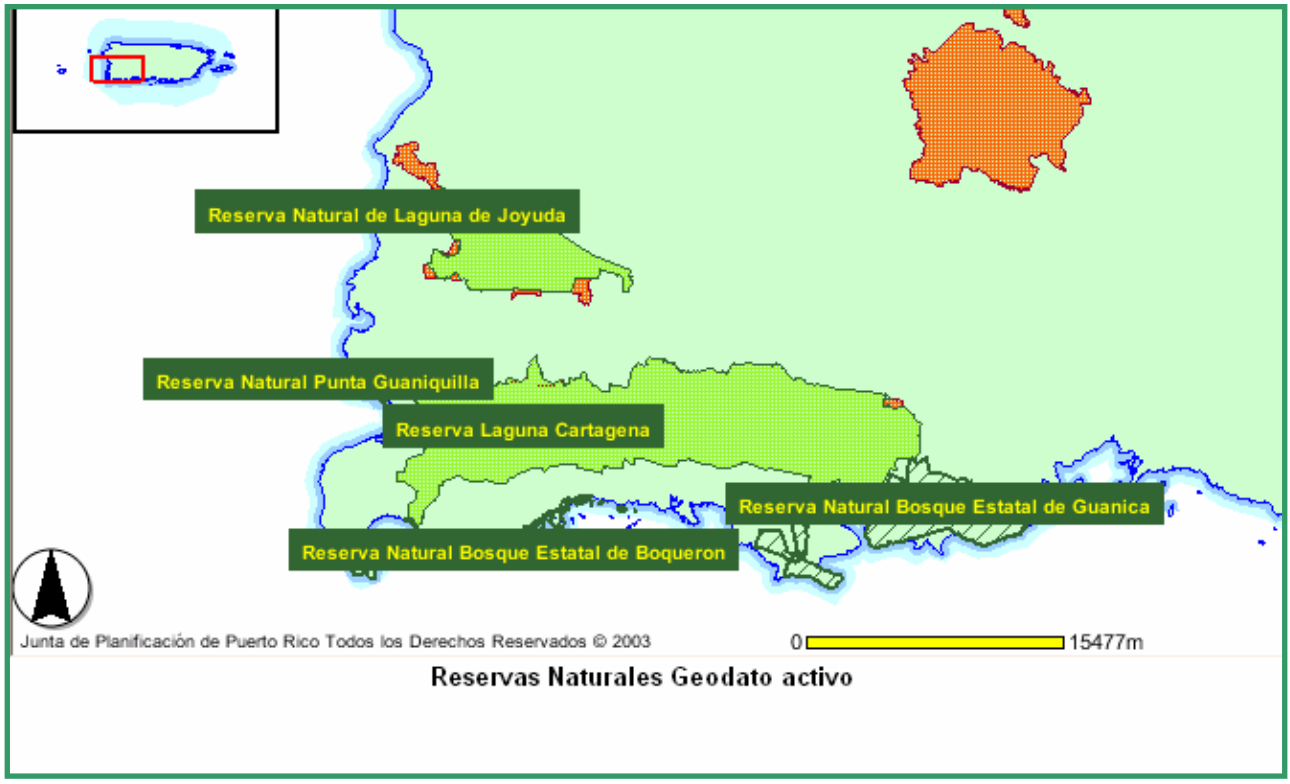



Source: Coastal Zone Management Program, Puerto Rico Department of Natural and Environmental Resources (DNER)

### Natural Reserve Areas

In addition to extend coral reef identified, the federal and commonwealth governments have stepped up efforts to preserve the island's animal and plant life through reserve such as:

**Figure 4. Natural Reserves in the West Part of the Southern Watershed of Puerto Rico**




**Punta Guaniquilla Reserve and Bird Sanctuary (Reserva Natural Punta Guaniquilla)**

This reserve portrays a good example of the diverse environments contained such as lagoons, swamps, limestone and rock formations, caves, palm and mangrove forests, cactus and other scrub vegetation.

**Cabo Rojo National Wildlife Refuge (Refugio de Vida Silvestre de Cabo Rojo), Boquerón State Forest (Reserva Natural Bosque Estatal de Boquerón) and La Parguera Nature Reserve (Reserva Natural de la Parguera)**

Cabo Rojo National Wildlife Refuge and the Boquerón State Forest lies separated by the Sierra Bermeja. The Cabo Rojo National Wildlife Refuge is run by the U.S. Department of Fish and Wildlife, is located just south of Boquerón. Support rare migratory birds here including the yellow-shouldered blackbird native to Puerto Rico and the flamingo. This is a major winter ground for migratory birds, including herons, songbirds and ducks, and more than 130 species of birds have been spotted in this area. On the coast of Lajas, La Parguera Nature Reserve includes mangrove keys, inlets and estuaries.

**Cabo Rojo Salt Flat (Las Salinas de Cabo Rojo)**

It is located in the southwestern portion of Puerto Rico and supports tremendous biological diversity. The Wetlands Reserve Program (WRP) provided 1.5 million dollars for the acquisition of 30-year WRP easement on approximately 1,238 acres**.**

**Boquerón Forest Bird Refuge (Refugio de Aves de Boquerón)**

It is administered by the Department of Natural and Environmental Resources (DNER), and consists of more than 400 acres of mangrove wetlands. It supports more than 60 species of both local and rare migratory birds at this wonderful bird refuge, as well as walking and biking trails. During the winter months mangrove canary, osprey, and a number of duck species migrate here.

**Joyuda Lagoon (Laguna de Joyuda)**

It is just north of Boquerón, is a mile long and half mile wide saltwater lagoon with a depth that rarely exceeds 4 feet. This is a 300-acre wildlife sanctuary where waterfowl and migratory birds come to prey on over 40 species of fish. This reserve is also home to the dynoflagellate micro-organisms that create a bioluminescent green glow in the water.

**Lagoon National Wildlife Refuge (Laguna de Cartagena)**

The present lagoon is a remnant of what was once a large open expanse of water and one of the most important freshwater habitats for migrant waterfowl and aquatic birds in Puerto Rico. In addition to the lagoon, there are uplands that include pastureland, abandoned sugarcane fields, and 263 acres in the foothills of the Sierra Bermeja. These hills, geologically the oldest in the Caribbean, protect native forest with many endemic plant species. The area is a stopover for neotropical migrants and several species of water birds. The endangered yellow-shouldered blackbird and peregrine falcon have been reported on the refuge.

**Guánica Forest (Bosque Seco de Guánica)**

It is located in the region between Ponce and Lajas, with 1,640 acres of subtropical dry land. The Forest has been declared an International Biosphere Reserve by UNESCO because of its unique dry forest vegetation the area has over 700 varieties of plants and over 40 species of birds.

**Punta Ballena Reserve (Reserva Punta Ballena)**

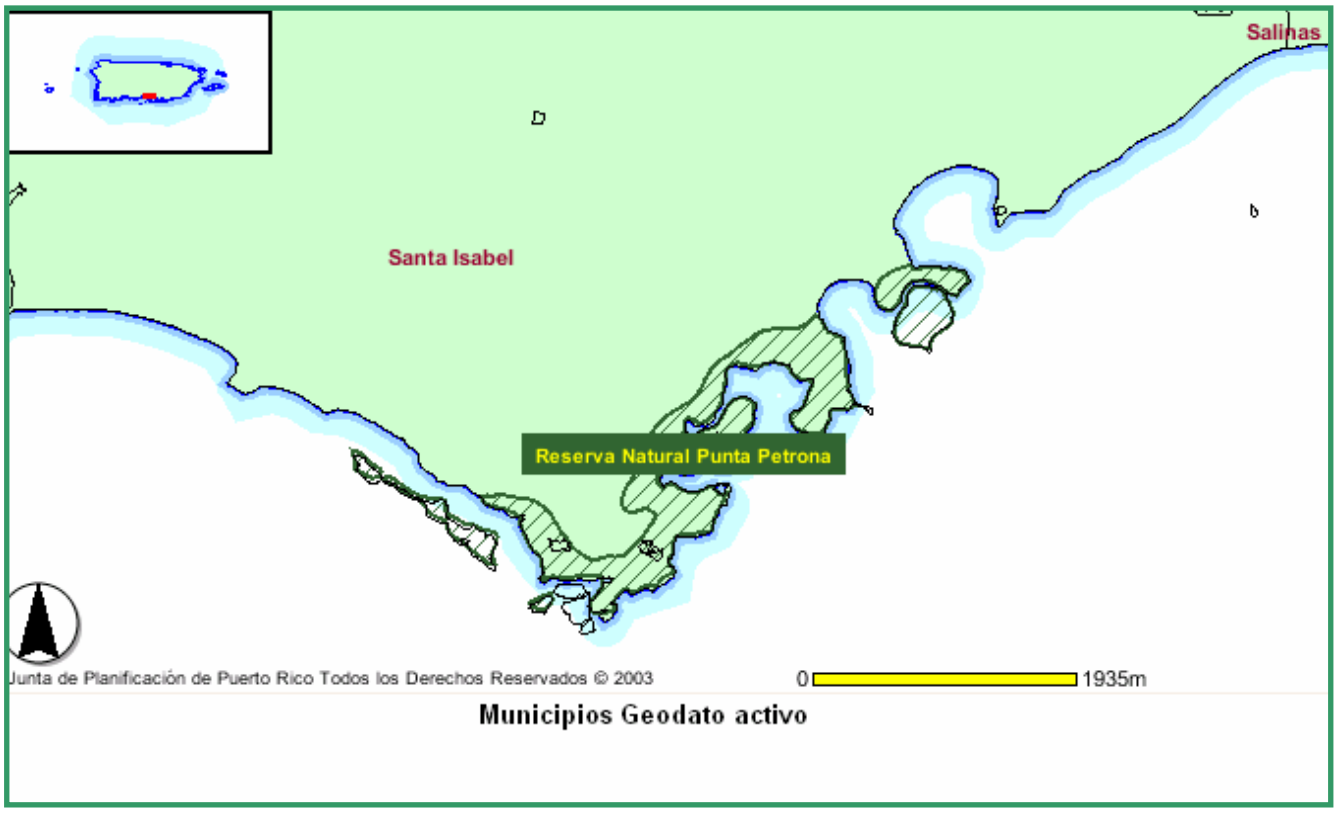
The mangrove forest is contiguous with the Guánica Dry Forest, and is also a biosphere reserve.

**Jobos Bay Reserve (Reserva Bahía de Jobos)**

It is the second largest estuarine area in Puerto Rico. The reserve is located in the southern coast of Puerto Rico, between the municipalities of Guayama and Salinas with 2,883 acres. It encompasses a chain of 15 tear shape mangrove islets known as Cayos Caribe and the Mar Negro area in western Jobos Bay. The reserve is home to the endangered brown pelican, peregrine falcon, hawksbill sea turtle, and West Indian manatee. The Jobos Bay Reserve is made up of subtropical dry forest, coral reefs, fringing and basin mangrove forest, sea grass beds, mangrove channels, salt and mud flats, lagoons, and freshwater wetlands.

**Natural Reserve Punta Petrona (Reserva Natural Punta Petrona)**

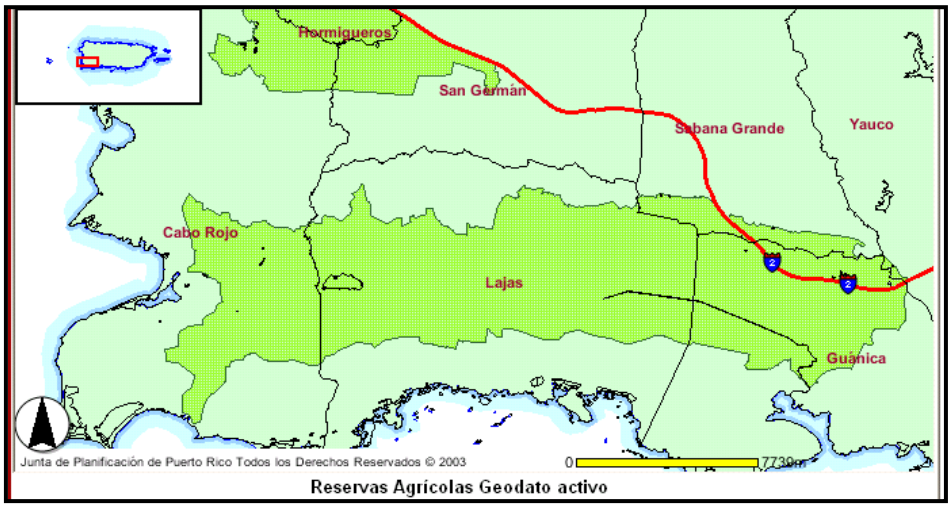
Located in Santa Isabel, designated on September 20, 1979. The Reserve contains coral reefs, mangroves, keys and sea grass. This is a productive area for commercial and recreationally important fisheries.



## Agricultural Reserve of the Lajas Valley

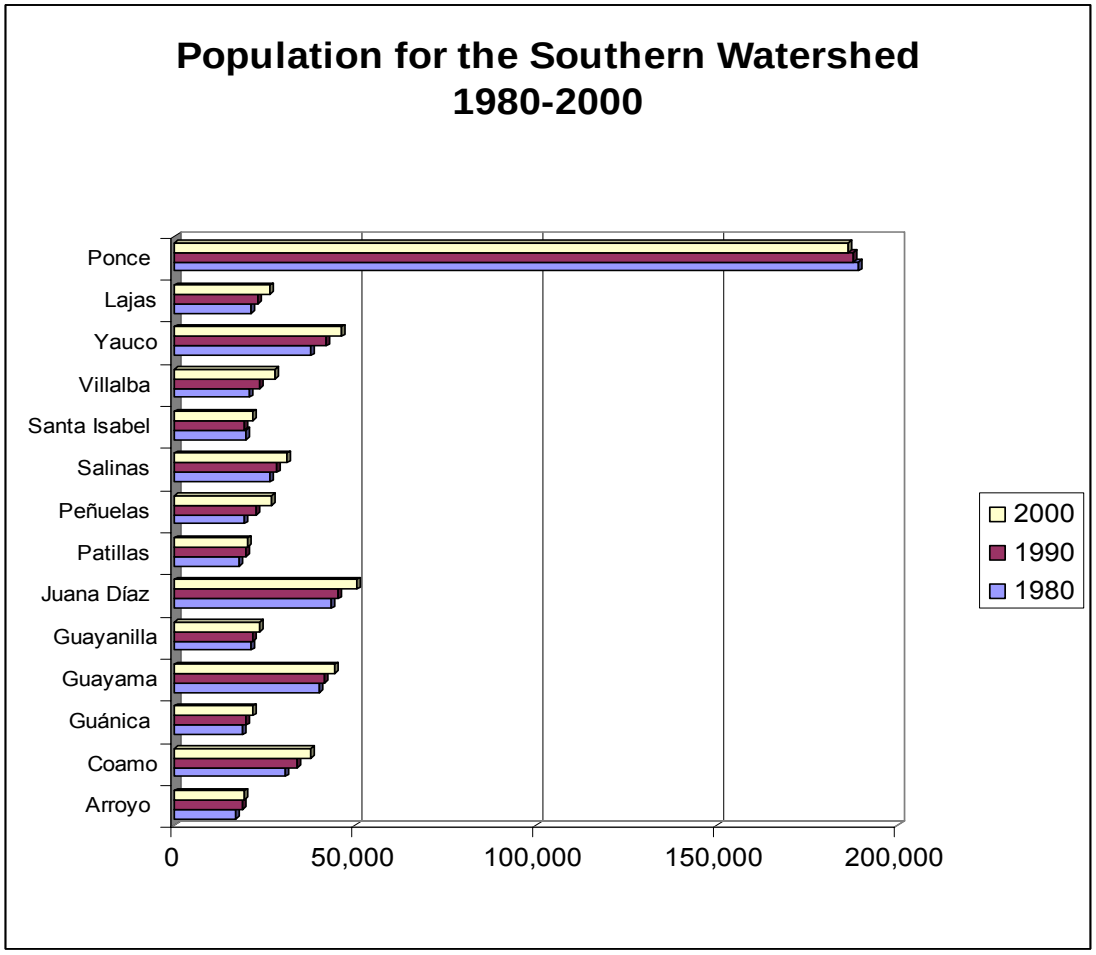
This reserve covers an approximate area of 43,382 acres, where 17,400 acres are in the irrigation district. According to the San Germán Area Soil Survey update this area is dominated by soils that are affected by shrink-swell processes. These processes in soils are related to the total content of clay, the content of fine clay and mineralogy. In addition to these properties several soils are affected by salts and/or sodium content. The saline-sodic soil is defined as a soil containing sufficient exchangeable sodium to interfere with the growth of most crop plants and containing appreciable quantities of soluble salts. In the Lajas Valley area the Aguirre, Cartagena, Fe and Guánica soil series are classified as saline-sodic soils. These soils cover an approximate area of 12,751 acres and are found mainly in depressions and on valley floors of the Semiarid Coastal Plain Major Land Resource Area.

**Lajas Valley Agricultural Reserve**



## Census and Social Data

The population of the Southern Watershed was about 583,687 in 2000 (U.S. Census Bureau, Census 2000 and Puerto Rico Planning Board). All municipalities within the watershed show an annual gross increase except Ponce. Population in all counties, except Ponce is under 50,000 persons.




According to the 2000 Agriculture Census there are about 2,590 farms with a total acreage of 156, 863 (28.8%) of the entire watershed extension. Average farm size is 60 acres, but most farms in the humid and semiarid upland have less acreage than average, while those at the alluvial are more than 100 acres.

About 2,768 operators are in the watershed of which 55% are full time operators. Although a significant amount of farmers are in the average age above 45 years, some counties have shown a low average age trend. These facts point to a special need for a growing group of operators who may need technical assistance to reach their goal and have lack of time to participate of NRCS conservation programs. Most operators are limited resource farmers and need economic support from government agencies.

## Conservation Progress Reporting

Performance reporting management system data over the last 3 years is gathered to analyze conservation system planned/applied and treatments applied as shown in Table 4. Total conservation systems planned through FY 02–04 represent a 12.8% of farmland while applied system a 22.3%. Total conservation systems planned and applied through fiscal years 2002-2004 represents 35% of the total farm land (156,863 ac. – Ag. Census). Applied conservation systems are 73% more than the planned. If this trend continues, we expect to have an increase in conservation application during next year.

Conservation practices accredited in progress reporting for FY-04 and FY-05 (until June 2005), are Brush Management – 314 (2,114 acres), Fence – 614 (146,335 feet), Pasture and Hayland Planting – 512 (591 acres), Use Exclusion – 482 (2501 acres), Hillside Ditches – 423 (6500 feet), Contour farming – 330 (1,224 acres), Contour Orchard – 331 (334 acres), and Alley Cropping – 311 (133 acres). Basically, this entire figure illustrates that conservation treatments applied addressed most resource concerns identified in this watershed.

Table 3. Southern Watershed Progress Report for FY 2002-2004

| PRMS Data | FY 02 | FY 03 | FY 04 | Avg/Year | Total |
|---|---|---|---|---|---|
| Total Conservation Systems Planned (Ac) | 5870 | 6239 | 8063 | 6724 | 20172 |
| Total Conservation Systems Applied (Ac) | 11305 | 11906 | 11691 | 11634 | 34902 |
| Conservation Treatment | | | | | |
| Residue Management, No-Till/Strip Till -329A (ac) | 1240 | 172 | 649 | 687 | 2061 |
| Residue Management, Ridge - 329B (ac) | 4097 | 3950 | 889 | 2978 | 8936 |
| Residue Management, Mulch Till – 329C (ac) | 408 | 0 | 4 | 137 | 412 |
| Nutrient Management - 590 (ac) | 3875 | 4990 | 3973 | 4279 | 12838 |
| Pest Management - 595 (ac) | 4695 | 4766 | 10147 | 6536 | 19608 |
| Irrigation Water Management (449) (ac) | 2363 | 2183 | 1637 | 2061 | 6183 |
| Prescribed Grazing (528A) (ac) | 7010 | 5275 | 1683 | 4656 | 13968 |
| Waste Storage Facility (313) (no) | 8 | 8 | 9 | 8 | 25 |
| Tree/Shrub Establishment (612) (ac) | 67 | 20 | 10 | 32.3 | 97 |

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